Forecasting Total Fertility Rate (TFR) In Slovenia

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Abstract - In this research article, the ANN approach was applied to analyze TFR in Slovenia. The employed annual data covers the period 1960-2018 and the out-of-sample period ranges over the period 2019-2030. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is stable in forecasting TFR in Slovenia. The results of the study indicate that annual total fertility rates in Slovenia are likely to remain around 2 births per woman over the out-of-sample period. Therefore, the authorities in Slovenia should create more demand for family planning services and address challenges being faced by adolescents and young adults in accessing sexual and reproductive health (SRH) services as well as women empowerment.

Keywords: ANN, Forecasting, Total fertility rate (TFR).

I. INTRODUCTION

Sexual and reproductive health is a key component of health and sustainable development (Starrs et al, 2018). Many developing countries are witnessing adverse maternal and neonatal health outcomes such as abortions, HIV infections and pregnancy related adverse outcomes aggravated by sexual and gender based violence (Glasier et al, 2006; Eczati et al, 2002).There is strong evidence to suggest that there are benefits in investing in reproductive health and spending in this sector is likely to have a positive impact on maternal and child health outcomes, and also reduce poverty (Borghi et al, 2006; Adam, 2004; Ensor, 2005; UNFHR, 2004; Jowett, 2000).The aim of this study is to project TFR in Slovenia using a machine learning algorithm. The results of the study will provide an insight of the likely fertility trends in Slovenia in the out of sample period. This will assist in policy formulation, planning and resource mobilization for the health sector, education and employment creation.

II. METHODOLOGY

The Artificial Neural Network (ANN) approach, which is flexible and capable of nonlinear modeling; will be applied in this study. The ANN is a data processing system consisting of a large number of highly interconnected processing elements in architecture inspired by the way biological nervous systems of the brain appear like. Since no explicit guidelines exist for the determination of the ANN structure, the study applies the popular ANN (12, 12, 1) model based on the hyperbolic tangent activation function. This paper applies the Artificial Neural Network (ANN) approach in predicting annual total fertility rates in Slovenia.

Data Issues

This study is based on annual total fertility rate (births per woman) in Slovenia for the period 1960 – 2018.The out-of-sample forecast covers the period 2019 – 2030.All the data employed in this research paper was gathered from the World Bank online database.

III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	A
Observations	47 (After Adjusting Endpoints)
Neural Network Architecture:	
Input Layer Neurons	12
Hidden Layer Neurons	12
Output Layer Neurons	1

Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.359667
MSE	0.039926
MAE	0.086922

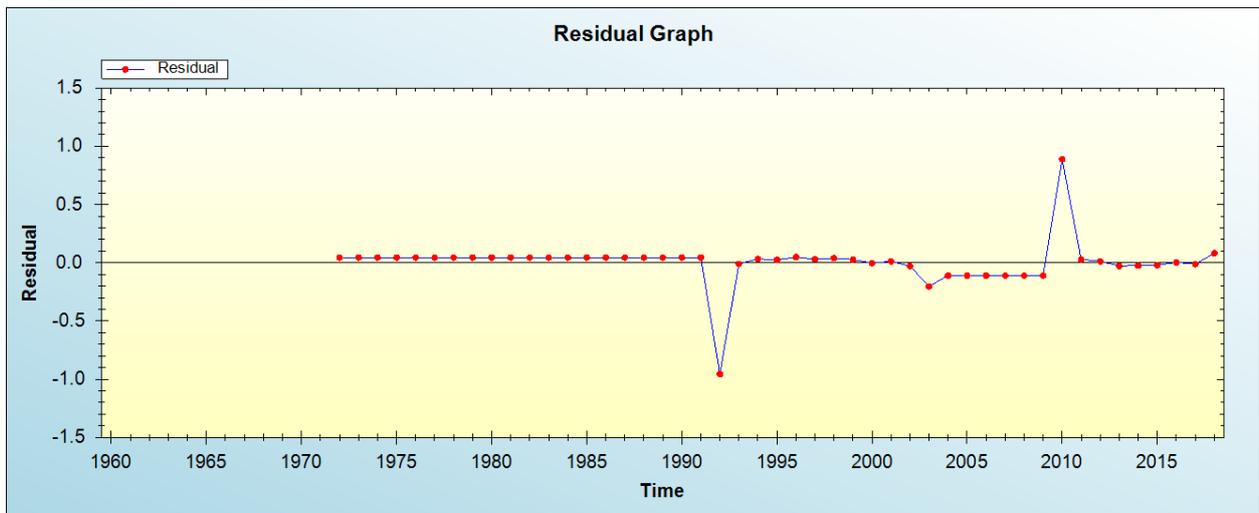*Residual Analysis for the Applied Model*

Figure 1: Residual analysis
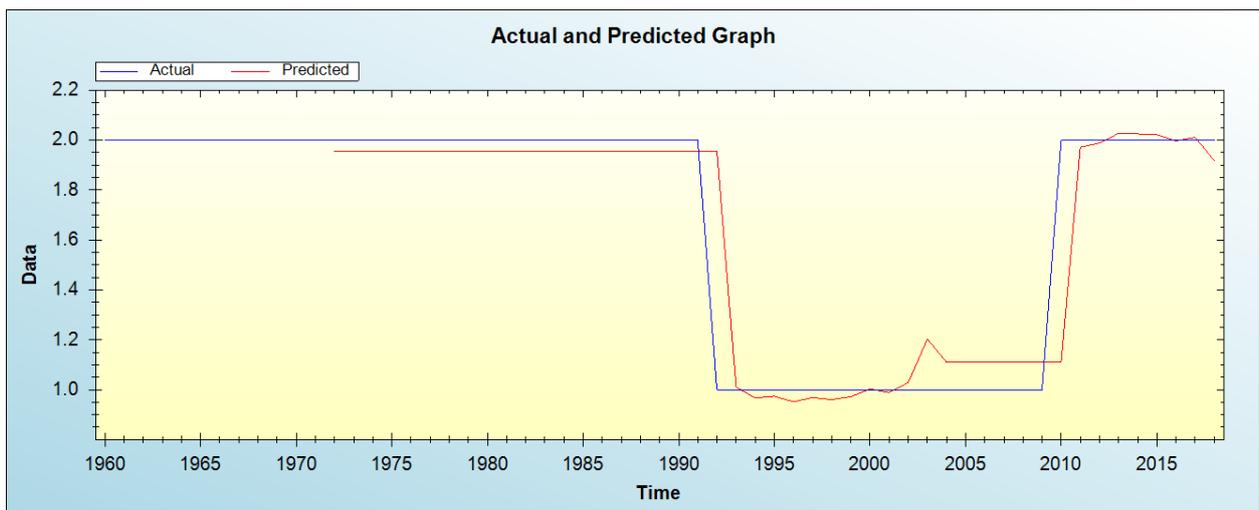
In-sample Forecast for A

Figure 2: In-sample forecast for the A series

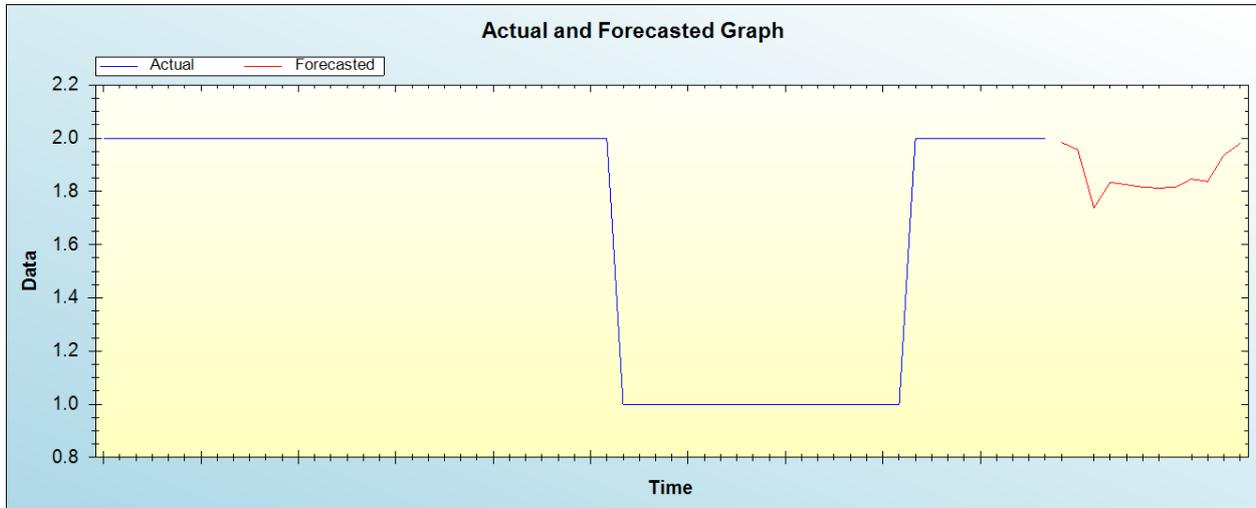*Out-of-Sample Forecast for A: Actual and Forecasted Graph*

Figure 3: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasts
2019	1.9843
2020	1.9563
2021	1.7382
2022	1.8340
2023	1.8249
2024	1.8159
2025	1.8124
2026	1.8158
2027	1.8466
2028	1.8373
2029	1.9370
2030	1.9799

The main results of the study are shown in table 1. It is clear that the model is stable as confirmed by evaluation criterion as well as the residual plot of the model shown in figure 1. It is projected that annual total fertility rates in Slovenia are likely to slightly decline over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

Machine learning with its high predictive accuracy is suitable for predicting total fertility rates around the globe. In this study we applied the multilayer perceptron neural network to predict total fertility rate in Slovenia. The model projections indicate that annual total fertility rates in the country are likely to remain around 2 births per woman over the out-of-sample period. Therefore, the government should create more demand for family planning services and address challenges being faced by adolescents and young adults in accessing sexual and reproductive health (SRH) services. The government should also engage on an empowerment drive for women to improve their labor participation and contribution to economic development.

REFERENCES

[1] Starrs A M., Ezeh A C., Barker G., Basu A., Bertrand J T., Blum R., Coll-Seck A M., Grover A., Laski L., Roa M (2018). Accelerate progress—Sexual and reproductive health and rights for all: Report of the Guttmacher–Lancet Commission. Lancet, 391, 2642–2692.

[2] Glasier A., Gulmezoglu A M., Schmid G P., Moreno C G., & Van Look P F (2006). Sexual and reproductive health: A matter of life and death. Lancet, 368, 1595–1607.

[3] Ezzati M., Lopez A D., Rodgers A., Vander Hoorn S., & Murray C.J (2002). Selected major risk factors and global and regional burden of disease. Lancet 2002, 360, 1347–1360

[4] Borghi J., Ensor T., Somanathan A., Lissner C., & Mills A. Mobilizing financial resources for maternal health. Lancet, 368:1457–65.

[5] Jowett M (2000). Safe motherhood interventions in low-income countries: an economic justification and evidence of cost effectiveness. Health Policy, 53:201–28.

[6] Ensor T., & Ronoh J (2005). Effective financing of maternal health services: a review of the literature. Health Policy, 75:49–58.

[7] Adam T., Lim SS., Mehta S., Bhutla ZA., Fogstad H., & Mathai (2005). Cost effectiveness analysis of strategies for maternal and newborn health in developing countries. BMJ, 331:1107.

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